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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|--|-------------|----------------------|---------------------|------------------|
| 10/735,886 | 12/16/2003 | Toshio Takayama | 031325 | 5693 |
| 23850 | 7590 | 01/14/2005 | EXAMINER | |
| ARMSTRONG, KRATZ, QUINTOS, HANSON & BROOKS, LLP 1725 K STREET, NW SUITE 1000 WASHINGTON, DC 20006 | | | PAREKH, NITIN | |
| | | | ART UNIT | PAPER NUMBER |
| | | | 2811 | |

DATE MAILED: 01/14/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/735,886

Applicant(s)

TAKAYAMA ET AL

Examiner

Nitin Parekh

Art Unit

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– The MAILING DATE of this communication appears on the cover sheet with the correspondence address –

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 09 November 2004.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-18 is/are pending in the application.
- 4a) Of the above claim(s) 7-17 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-6 and 18 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 16 December 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date <u>12/16/03</u> | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Election/Restriction

1. Applicant's election without traverse of Group I, claims 1-6 and 18 in Paper No. 2 is acknowledged.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 1-4, 6 and 18 are rejected under 35 U.S.C. 102(e) as being anticipated by Takata et al. (US Pat. 6500675).

Regarding claims 1-4 and 6, Takata et al. disclose a semiconductor device (see Fig. 6) having a substrate (1 in Fig. 6) comprising a multilayer interconnection structure (MIS) formed on the substrate, the MIS comprising:

- a first interconnection/electrode layer (FIL- 9b in Fig. 6) including a interconnection pattern made of material such as copper (Col. 9, line 17)
- an interlayer insulation film (11 in Fig. 6) formed on the FIL

- a second interconnection/electrode layer (SIL- 13b in Fig. 6) formed on the interlayer insulation film, the SIL including a interconnection pattern made of material such as aluminum (Col. 9, line 56)
- a via-hole (see the hole filled with 12b in Fig. 6) formed in the interlayer insulation film so as to expose the copper interconnection pattern
- a metal plug formed in said via-hole (12b in Fig. 6) so as to connect the FIL and the SIL electrically, metal plug being formed of a material such as tungsten and the via-hole having a high depth/diameter ratio of about 2.0 (see Fig. 6)
- a stacked metal layer/film (see 12a in Fig. 6) formed between an outer wall of the tungsten plug and an inner wall of the via-hole, the metal layer/film being formed of the stack of conductive nitride layer including a first and second nitride layers such as tantalum nitride (TaN) and titanium nitride (TiN) respectively, and
- the stack of the conductive nitride film being defined by an inner wall contacting with said outer wall of the tungsten plug and an outer wall contacting with the inner wall of the via-hole (Col. 9, lines 50-54), such stack structure providing the second nitride film being stacked inside/on the first nitride film

(Fig. 6; Col. 11, line 30- Col. 12, line 40; Col. 7-9; Fig. 1-5).

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Takata et al. (US Pat. 6500675) in view of Brown (US Pat. 6306732).

A. Regarding claim 5, Takata et al. disclose substantially the entire claimed structure as applied to claim 1 above, except the nitride film showing corrosion resistance.

Brown teaches using a multilayered stack of barrier layers having compositions such as TaN and TiN to provide an enhanced/stronger barrier against electromigration/corrosion and stress in an interconnect structure wherein the stack comprises a superior barrier composition such as TaN having the desired composition/structure, thickness and uniformity so that the electromigration/corrosion reliability for the interconnect can be improved and void formation can be reduced (see Col. 12, line 21- Col. 13, line 3; Col. 7-13).

It would have been obvious to a person of ordinary skill in the art at the time invention was made to incorporate the nitride film showing corrosion resistance as taught by Brown so that the reliability can be improved and the stress related defects/void formation can be reduced in Takata et al's device.

B. Regarding claim 5, using the fluoride gaseous source of tungsten for forming the tungsten plug do not distinguish over Takata et al. and Brown, because only the final product/structure is relevant, not forming the tungsten using the “gaseous source”, “plasma source” or “preclean and selective deposition”. Note that a “product by process” claim is directed to the product per se, no matter how actually made, In re Hirao, 190 USPQ 15 at 17 (footnote 3). See also In re Brown, 173 USPQ 685; In re Luck, 177 USPQ 523; In re Fessmann, 180 USPQ 324; In re Avery, 186 USPQ 161; In re Wertheim, 191 USPQ 90 (209 USPQ 554 does not deal with this issue); and In re Marrosi et al., 218 USPQ 289, all of which make it clear that it is the patentability of the final product per se which must be determined in a “product by process” claim, and not the patentability of the process, and that an old or obvious product produced by a new method is not patentable as a product, whether claimed in “product by process” claims or not. Note that applicant has the burden of proof in such cases, as the above case law makes clear. See also MPEP 706.03(e).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nitin Parekh whose telephone number is 571-272-1663. The examiner can normally be reached on 09:00AM-05:30PM.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie Lee can be reached on 571-272-1732. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9318.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

NP

01-10-05



NITIN PAREKH

PRIMARY EXAMINER

TECHNOLOGY CENTER 2800